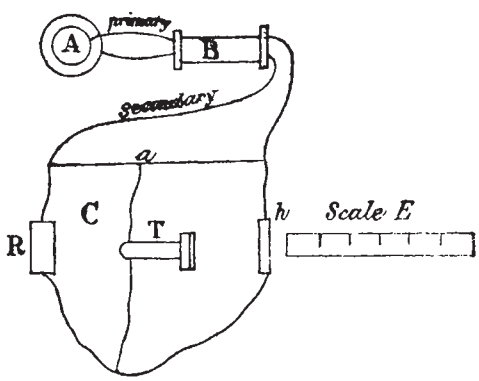
earthquake of January, 1869, the direction of the loud banging sounds like artillery was carefully marked against a peak in the Naga Hill range. Bearings by the prismatic compass subsequently sent to Calcutta to Dr. H. B. Medlicott, turned out to be within 3° of the true line to Cheduba and Ramree, the active volcanic centre, 550 miles off. I cannot exactly see how the difference of the *intensity* assists us in directing to the sound. I find I judge that best by facing it and remaining still, and verify the direction best by *looking* (with the eyes only) about 10° to right, and then 10° to left, which, if I do not move the head, soon enables me to fix by eye the direction pretty close.

Sibsagar, Asam, October 27 S. E. PEAL

An Audible Photometer

IN your issue of September 22 (vol. xxiv. p. 491, British Association Reports) Mr. Lant Carpenter mentions an idea of his about an "audible photometer." The same idea occurred to me some six months ago. As my plan seems to be much more simple than Mr. Carpenter's, dispensing with intermitting beams and rotating disks, perhaps you will allow me a little space to describe it. I require only one photophonic receiver, whereas Mr. Carpenter mentions "two precisely similar receivers," which is difficult, if not wholly impossible, to obtain. A is a small battery, B an induction-coil with the ordinary vibrating magnetic interrupter, and with a high-resistance secondary coil; C is the Wheatstone-bridge combination, S E a selenium cell, with its working surface



turned to the scale E; R is a high resistance of about the value of the selenium cell; *a* is a sliding contact, T a high-resistance telephone. Now I place on the scale E a standard candle at a distance *d* from selenium cell, and move the sliding contact till no sound is emitted from the telephone. Then the wire connections are left wholly unaltered, and the candle is taken away. Now I place the light I wish to compare with the standard candle on the scale E, and move it along the scale till the telephone is again silent. Be the distance of the light from the selenium cell now D, then its luminous intensity is

$$\frac{D^2}{d^2} \text{ standard candles.}$$

As, on after-thought, I greatly doubted the fitness of selenium for photometric purposes (which doubts became the stronger the more I read about the subject), I did not pursue my idea, which could only result in an addition to the long list of practically useless photometers. The above may perhaps be used as a college experiment for demonstrating the law of the square of distances. J. W. GILTAY

Delft, November 21

Extraordinary Atmospheric Phenomenon

I INCLOSE a paragraph from the Glasgow *Evening Citizen* of this date relating to that peculiar form of lightning known as fire-balls. The explanation of the explosion in the funnel is, I think, erroneous, it having been caused by the explosion of the fire-ball, thus driving out the smoke by the fire-doors. The aurora was very bright here on Wednesday evening, showing Piazzi Smyth's line with a small direct vision spectroscope. Before the eye became sufficiently sensitive for measurement, clouds cut off the bright part. The aurora was a general bright northern glow without streamers, and was observed brightest a little after eight (p.m.). These notes may be of use to you in connection with those of other observers. J. B. HANNAY

Cove Castle, Loch Long, N.B., November 25

Extraordinary Phenomenon of the Storm

Those on board the Campbelton Steamer *Kinloch* (Capt. Kerr), which left Greenock on its usual run about half-past eleven o'clock on Tuesday morning after the storm that raged during the night, had a somewhat extraordinary experience while passing down the Firth. The vessel was enveloped in a dense shower of hail, and for some time it was awfully dark, and occasionally the vessel was lit up by vivid flashes of lightning. One of the flashes was very bright, and its shape was something like that of the arteries of the human body, with a central column all shattered and broken. About noon, while opposite the Cloch Lighthouse, and not far from the shore, the captain observed immediately over the ship what appeared to be a series of clear balls of lightning, each about a foot in length, and resembling a chain, except that they were disconnected. This phenomenon was quickly succeeded by an explosion in the funnel of the steamer, and several balls of fire upon the bridge running about, and then bounding off into the water. The first impression of the spectators was that something had exploded on board, but on inquiry it was found that this was not the case. The mate stated, however, that a ball of lightning had almost struck him where he stood. A fireman rushed upon deck to see what had happened, as the engine-room was filled with smoke, and a choking sensation was experienced below. The explanation appears to be that a portion of the lightning had passed down the funnel until its force was spent by the fire, and the sudden recovery of the draught of the funnel afterwards accounted for the loud report that was heard. The captain, in his long experience at sea, never encountered such a phenomenon before, and it may be taken as an indication of the extraordinary atmospheric forces which had been at work during the storm, and which seemed to centre in this locality.

Papin

IN the review of my "Life and Letters of Papin"[1] in NATURE, vol. xxiv. p. 378, the hope is expressed that I might succeed "to fill the *lacunæ* in the career of this remarkable man." The only important blank remaining now in our knowledge of Papin's life consists in our ignorance of the time of his death. We may rest assured that he died in London, and therefore this blank is not likely to be filled but by a person who is familiar with the city and its inhabitants of the present and of the beginning of last century. Papin died about 1712. During 1709 he lived at "Madam Portal chez M. Charron, apothecaire dans Compton Street, proche St. Anne." As it is not probable that he changed his lodgings before his death a search in the registers of the district to which Compton Street belonged (if they are in existence) would lead to results equally important for the history of science and for that of technology. Maybe a reader of this note who enjoys such opportunities will render me his assistance in this thankful task.

I avail myself of this opportunity of correcting a few slight mistakes which have found their way into the otherwise excellent *résumé*. Not Papin but Leibnitz is the author of the letter of February 4, 1707, which contained the first idea of the "hot-air engine." Leibnitz is therefore the inventor of the same. That boat, in which Papin left Cassel in 1707 to sail to Bremen, was not a "steam propeller boat," but a small ship with paddle-wheels to be worked by the sailors. It was not Papin's intention to proceed to England in that boat. He left Cassel with proofs of the favour and goodwill of the Landgraf, which remained unchanged to the end. Lastly, before Papin no steam-engine existed; he is the real inventor of the same, for he in 1690 first announced the idea, and tested it by experiments of utilising the pressure of steam as motive power for engines. This, his first engine, had a piston inside a cylinder. Such an arrangement was not at all new at that time; other machines had the same, as, for instance, the gunpowder engine of Huyghens, which suggested the invention of Papin. Leibnitz corresponded with the inventor about this engine much later, and made valuable propositions, but the correspondence of these

[1] Leibnizen's und Huygens' Briefwechsel mit Papin, nebst der Biographie Papin's und einigen zugehörigen Briefen und Aktenstücken. Bearbeitet und auf Kosten der Königlichen Preussischen Akademie der Wissenschaften herausgegeben von Dr. Ernst Gerland. Berlin, 1881. Verlag der Königlichen Akademie der Wissenschaften.

two *savants* did not commence before 1692. It is therefore out of the question to credit Leibnitz with the invention of the steam-engine or even with the application of the piston principle in the steam-engine. E. GERLAND

Cassel

A Question for Naturalists

MR. PAUL DU CHAILLU, in his "Land of the Midnight Sun," tells us that "the time of dropping the horns in a herd (of reindeer) varies from March to May." This may be true as regards the young males up to two or three years of age, and of the does, but it is questionable as regards the full-grown males. If my memory serves me correctly, the full-grown bucks brought to this country with some Lapps a year or two ago, and exhibited at the Aquarium, shed their horns in December or January. The experience of a gentleman—one of the highest authorities in such matters—who holds a most important position at the Zoological Gardens, supports my view. Can the Lapps have two kinds of reindeer which shed their horns at different seasons? I know that the full-grown male reindeer of the barren grounds of America drop their horns in the latter part of November and in December (which does away with the erroneous idea that this animal used the broad brow antler as a shovel for clearing away the snow so as to reach his food); the young buck of two or three years retains his horns until spring, and the full-grown female does not shed her horns until May or June, usually after having dropped her calf. J. RAE

4, Addison Gardens, November 19

Earthquake Vibrations

IN a note in your issue of August 25 on my account of the earthquake of March 8, 1881, felt in Japan, it is said "that from the phenomena of the shock and from experiments on artificial earthquake waves produced by letting an iron ball weighing about one ton fall from a height of about thirty-five feet, Mr. Milne agrees that the waves that are felt are transverse to the line of propagation of the shock." Lest it should be thought that all the earthquakes which shake the residents in Japan are composed of transverse vibrations, allow me to make the following brief statements:—

1. In the earthquake of March 8 my seismographs chiefly indicated east and west motions, whilst time observations made in Yokohama, as compared with similar observations made in Tokio, showed that the earthquake must have travelled up from the south. This particular earthquake, as recorded in Tokio, might therefore be called a transverse or diagonic shock.

2. In other shocks normal or direct vibrations are the most prominent. These shocks might be called euthutropic.

3. Others again are compounded of direct and transverse motions, and might therefore be called diastrophic. Thus my records of the shock of July 5, 1881, very clearly showed a variation in the direction of the motion of the ground. At the commencement of the shock the motion was N. 112° E.; 1½ second after this the direction was N. 50° E.; ⅔ second more it was N. 145° E.; and after a similar interval N. 62° E. These and other changes were very clearly indicated in the diagram written by a double-bracket seismograph.

4. Anaseismic shocks, or those where vertical motion is prominent, which vertical motion may sometimes be a component of the transverse motion, appear to be rare.

5. In the artificial earthquakes produced by the blow of a falling ball the seismographs very clearly wrote both normal and transverse vibrations. When bracket-ring seismographs were used, these two sets of vibrations could be separated and their respective velocities, &c., measured. When a single component seismograph was used, the resultant motion due to the composition of these two sets of vibrations was recorded. The results of these experiments, which experiments were made in conjunction with my colleague Mr. T. Gray, will very shortly be published. JOHN MILNE

Imperial College of Engineering, Tokio, Japan, October 13

The Geological Survey of Italy

MY friend Mr. W. Topley, in his interesting account of the Italian Geological Survey (NATURE, vol. xxv. p. 86), is quite right when he states that the geological surveyors seem now to have definitely fixed the position of the Carrara marbles in the Trias. If, however, he means to imply that the geological world at large will accept this decision, I fear he is mistaken. The patient toil, spread over many years, and carried on by M. Coquand with more than due regard to Buffon's advice to geologists, "*Il faut voir beaucoup et revoir souvent*," gives him such authority when speaking on the structure of the Apuan Alps and the Campigliese, that nothing but the most absolute proof that he is wrong in regarding the metamorphic marbles of Carrara, as well as those of the Pyrenees (St. Béat, &c.), as being of Carboniferous age, will prevent foreign students of Italian geology from accepting his views on the matter. I have read, I think, all that has been written in Italy by De Stefani and others on the point in question since the publication in full of M. Coquand's mature conclusions in the *Bulletin de la Société géologique de France*, in 1874, and I still regard his position as entirely unassailed. In 1876 I published in the *Geological Magazine* a short *résumé* of M. Coquand's results, to which I would refer any who are interested in the subject. G. A. LEBOUR

OUR ASTRONOMICAL COLUMN

THE PROVINCIAL OBSERVATORIES OF FRANCE.—We have before us the "Rapport adressé par le comité consultatif des observatoires astronomique de province, à M. le Ministre de l'Instruction Publique," signed by M. Lœwy, as reporter. In the year 1880 a great impulse appears to have been given to what is termed the reform of French astronomy, a considerable grant having been obtained by the Minister of Public Instruction, which allowed of most material improvement in the equipment of the several observatories of the provinces. Stress is laid upon the reorganisation of the observatory at Algiers, which is placed under the direction of M. Trepied, and the Committee urge that special attention should be given to the proper equipment of an establishment which has the advantage of so exceptional a climate. The observatory at Marseilles is still under the direction of M. Stephan, who has done such excellent work for many years past, and MM. Borrelly and Coggia were the assistant-astronomers in 1880: a revision of the star-catalogue formed by Rümker at Hamburg is in progress at Marseilles. At Toulouse, M. Baillaud is the director; he proposes to devote special attention to the observation of the variable stars. In 1880 a regular course of observations of the solar spots was maintained, and it is mentioned that during the nights August 9–13 three observers counted upwards of 1200 meteors of the Perseus shower. At the observatory of Bordeaux, M. Rayet is director; an equatorially-mounted refractor of 14-inches aperture has been ordered from Merz of Munich, and a second of 8-inches aperture is also to be provided. Two observers were engaged in 1880 upon a revision of the charts of Chacornac. The observatory at Lyons includes four stations, three of them devoted to meteorology: the astronomical station is at Saint-Genis-Laval, where M. André is director, and the principal instrument in process of construction in 1880 was a meridian-circle of 6-inches aperture by Eichens. The State-subvention to these observatories is 81,000 francs, and further funds are provided by the cities of Bordeaux, Marseilles, and Toulouse for their respective establishments.

The Report is a very encouraging one in its bearing on the advancement of practical astronomy in France.

DENNING'S COMET.—Dr. Hartwig has corrected his first ellipse with the aid of an observation by Prof. Winnecke on November 19, in addition to earlier ones at Marseilles and Strasburg, and now finds the period of revolution 8·8334 years, or 3226·4 days. With the corrected orbit the nearest approach to the orbit of Jupiter occurs in 222° 35′, heliocentric longitude, where the distance is 0·154, the comet is at this point about 593 days before perihelion passage. It approaches nearest to the orbit of Venus 5·6 days after perihelion passage in longitude 30° 45′, where the distance is only 0·0226, while in longitude 82° 35′, about 36·7 days after perihelion passage the comet's distance from the earth's orbit is at a minimum of 0·0346.

A NEW COMET.—A Dunecht circular issued on November 22 contained elements of a comet from observations made by Mr. Wendell at the observatory of Harvard College, U.S., on November 17, 19, and 20. Prof. Winnecke has observed this comet as follows:—

	Strasburg, M.T.				R.A.				Decl. N.		
	h.	m.	s.		h.	m.	s.		°	′	″
Nov. 25	9	54	33	...	0	30	39·46	...	63	52	2
26	6	3	31	...	0	25	25·44	...	62	35	21

These places differ considerably from the ephemeris telegraphed to Dunecht.